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Organization: NASA Langley Research Center
Instrument Name: LARGE (Langley Aerosol Research Group)
Mission: CAMP2Ex
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Platform: NASA P-3
Location: Philippines region. See CAMP2EX-MetNav_P3B data files for exact position and altitude
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This file refers to general instructions for using LARGE data.

LARGE data are reported under multiple DataIDs. Users are highly recommended to read individual file headers for specific information.

The following DataIDs are part of the CAMP2Ex LARGE suite: SP2, SMPS, PILS, PILS-COND, OPTICAL, MICROPHYSICAL, LAS, InletFlag, CLOUDWATER, APS, AMS, and AMS-CVI.

All LARGE measurements, unless otherwise stated, have the following characteristics and caveats:
- In-situ observations: made at the aircraft altitude/time by sub-sampling ambient air using an inlet and cabin-mounted instrumentation
- Inlet = "Clarke" style forward-facing shrouded solid-diffuser that is operated iso-kinetically. Based on results published in McNaughton et al. (2007), this limits in-situ sampling to particles with aerodynamic diameter less than 5.0 micron (50% cutoff).

  McNaughton, Cameron S., Antony D. Clarke, Steven G. Howell, Mitchell Pinkerton, Bruce Anderson, Lee Thornhill, Charlie Hudgins et al. "Results from the DC-8 Inlet Characterization Experiment (DICE): Airborne versus surface sampling of mineral dust and sea salt aerosols." Aerosol Science and Technology 41, no. 2 (2007): 136-159.

- Data are reported at standard temperature and pressure (273.15K and 1013mb), either directly through instrument operation or corrected in post-processing. **Users should divide any LARGE parameter by "stdTP", which is archived in the MICROPHYSICAL and OPTICAL data files, for ambient conditions.**
- All LARGE measurements are subject to cloud contamination, which typically manifests as high frequency spikes in many of the aerosol measurements, a result of droplet shattering on the inlet tip. **These contaminated data are NOT removed** and can readily be seen during most flights, especially in CPC and size distribution measurements. Cloud microphysical and/or relative humidity observations should be used to filter out these date before use.
- A subset of LARGE instrumentation was actively switched from the "Clarke" inlet to a Counterflow Virtual Impactor (CVI) inlet (i.e., AMS, LAS, SP2). AMS data for the CVI are already segregated in a separate DataID (AMS-CVI), while LAS and SP2 data users should refer to the InletFlag file for information on the inlet state.
- The sample relative humidity varies with ambient conditions and P-3 cabin temperature. Most measurements are passively dried, since the cabin temperature is often higher than ambient. For those measurements that require dry conditions (e.g., scattering coefficient, absorption

coefficient, LAS size distributions), active sample drying (by Nafion) is utilized and documented in the file header.

- Polystyrene latex spheres are used to calibrate instrument response and sizing accuracy during a subset of flights. These data are removed as -9999 in the datasets.
- All LARGE data are time-synched to DLH water vapor on a flight-by-flight basis to account for differences in instrument response and transport times inside the aircraft. Please use care interpreting data at time scales less than 5-sec due to synchronization variability.
- Excessive cabin temperatures in the P-3 resulted in pump failures that affected the full LARGE measurement suite, mostly earlier in the campaign. These time-periods are not recoverable and have been removed from each dataset using -9999 flagging.

The following is a short description of measurements and caveats for each DataID:

SP2
- Single Particle Soot Photometer.
- Mass concentrations of black carbon mass by laser-induced incandescence
- Relevant size range: 100-700nm diameter
- During CAMP2Ex flights, excessive heat caused YAG laser power to decrease sufficiently so incomplete incandescence was observed. These data are not recoverable and have been removed, sometimes resulting in large periods of -9999.
- Size distributions in BC-equivalent diameter are available upon request.

SMPS
- Scanning Mobility Particle Sizer.
- Size distributions by differential mobility analysis and condensation particle counting
- Relevant size range: 3-100nm diameter
- Data are recorded at 60s time resolution.
- **Because of slower time response, care should be taken when conditions (i.e., particle number concentrations) vary significant at higher frequency.**

PILS
- Particle-Into-Liquid-Sampler
- Mass concentrations of water-soluble aerosol chemical components
- Relevant size range: 50-4000nm diameter
- Acid and base denuders were NOT used inline with the PILS, users may need to consider the impact of gas phase contributions for semi-volatile species. Contact the instrument PI (ewan.c.crosbie@nasa.gov) for more information.
- Samples that contain cloud penetrations should be used with caution
- 'Redundant' AMS species should be treated independently (e.g., PILS-SO4 ≠ AMS-SO4) since each technique has complexities that may result in different instrument response.

PILS-COND
- Online aqueous conductivity measurement from the PILS
- Please contact instrument PI (ewan.c.crosbie@nasa.gov) for proper use.

OPTICAL
- 3 wavelength scattering coefficient by integrated nephelometry
- 3 wavelength absorption coefficient by Particle Soot Absorption Photometer (PSAP)
- Relevant size range: bulk, less than 5000nm diameter
- Secondary data products are calculated after appropriate smoothing and thresholding is applied, depending on the parameter. Please refer to file header for details.
- **Please use caution when averaging ratioed parameters (e.g., SSA and angstrom exponents)**

MICROPHYSICAL
- Direct measurements of particle number concentration from three parallel condensation particle counters (CPCs)
- Integrated statistics from native size distributions; number, surface area, and volume for submicron and supermicron size range.

LAS
- Laser Aerosol Spectrometer
- Optical Size Distributions
- Size distributions are relevant for aerosol with a refractive index of 1.53, based on calibrations with ammonium sulfate. This should be sufficient for most sampling during CAMP2Ex, but care should be taken when interpreting coarse-mode data when dust is present or for accumulation-mode distributions when significant absorption is observed.

InletFlag
- Identifies the state of sampling for AMS, LAS, and SP2 instruments:
  - 0 = ambient
  - 1 = CVI
  - -9999 = transitions between inlets, or missing data

CLOUDWATER
- Aqueous mass concentrations derived by ion chromatography
- Cloud water sample pH
- Total organic carbon mass concentrations

APS
- Aerodynamic Particle Sizer
- Relevant size range: 550-5000nm diameter
- Use caution for sub-micron diameters as counting efficiency is reduced for smaller particle sizes.
- Note that bin width (dlogD) is 0.05 for submicron particles and 0.1 for super-micron particles.
- **Aerodynamic sizing (D_{aero}) is a function of particle density and shape factor. Comparisons with other instruments require conversion to a geometric diameter (D_{geo}) as follows:**
  $D_{geo} = D_{aero}*sqrt(shape\_factor/density)$

AMS
- Aerodyne High-Resolution Time-of-Flight Aerosol Mass Spectrometer
- Measures chemically-resolved non-refractory mass concentrations
- Relevant size range: 60-600nm vacuum aerodynamic diameter
- Mass concentrations and m/z tracers are derived from unit-resolution data

- m/z tracers are provided for cursory analysis and can be interpreted as follows. These definitions are general and caution should be used in interpretation:

m/z	Target Species	fragment
mz42	Amines	$C_2H_4N^+$
mz43	Mixed hydrocarbon	$C_3H_7^+$ or $C_2H_3O^+$
mz44	Oxidized hydrocarbon	CO_2^+
mz55	Aliphatic hydrocarbon	$C_4H_7^+$
mz57	Aliphatic hydrocarbon	$C_4H_9^+$
mz58	Sea-salt (marine)	$Na^{35}Cl^+$
mz60	Biomass burning	$C_2H_4O_2^+$
mz79	MSA (marine)	$CH_3SO_2^+$
mz91	Aromatic hydrocarbon	$C_7H_7^+$

- AMS collection efficiency is set at 1.0 for all CAMP2Ex data, based on initial comparisons with LAS integrated volume, and secondarily with PILS-sulfate. Because this correction factor varies with particle composition and phase, variability may exist that is not yet accounted for in the dataset. Please contact instrument PI (luke.ziemba@nasa.gov) for more details.
- AMS was operated in FastMS mode with 1-Hz sample rate. In post-processing, data were averaged to 30-sec resolution and CVI periods have been removed. If 1Hz data is necessary for your analysis, please contact instrument PI.

AMS-CVI
- AMS measurements ONLY for CVI sampling.
- Data are archived as mass fractions, where sulfate, nitrate, ammonium, chloride, and organics are ratioed to TOTAL mass from the AMS. Thus, these ratios will sum to unity by definition. m/z fragments are ratios with organic mass concentrations. Since these tracer m/z only represent a subset of the total organic mass, the sum of the archived m/z mass fractions will not be unity.
- Data are presented for each switch onto the CVI inlet. These periods likely contain a combination of cloud-free and cloudy data. Mass fractions are not sensitive to cloud-free conditions as mass concentrations outside of cloud (while on CVI) are zero. Additionally, multiple cloud elements are often sampled during a single CVI switch, so the archived mass fractions often represent a composite of multiple clouds. For cloud-by-cloud analyses, please contact the instrument PI.

Revision History

Rev#	Date	Comments
0	7/8/2020	Original document